Ammonia and nitrous oxide emissions from grazing cattle in Kenya

Mercedes Ibañez[1], Marko Kvakic[2], Eugenio Díaz-Pinés[3], Klaus Butterbach-Bahl[2, 3], Alberto Sanz-Cobena[4]

[1] Universidad de Lleida, Departamento HBJ-ESTSEA (Av. Alcalde Rovira Roure, 191 25198 Lleida, Spain)

[2] International Livestock Research Institute (ILRI), PO Box 30709, Nairobi, Kenya

[3] Karlsruhe Institute of Technology – Institute of Meteorology and Climate Research, Atmospheric Environmental Research (KIT/IMK-IFU) Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen, Germany

[4] Escuela Técnica Superior de Ingenieros Agrónomos (Universidad Politécnica de Madrid, Ciudad Universitaria, 28040, Madrid, Spain)

a.sanz@upm.es

Palabras clave: livestock, grazing, ammonia emissions, GHG, Africa.

Fertilized crops and livestock management are the main anthropogenic sources of ammonia (NH_3). Ammonia emissions imply a N loss from cropping systems and have negative effects on ecosystems and human health. In Africa, it is believed that a substantial proportion of NH_3 emissions results from widespread livestock management, whereas inorganic fertilizers might be of low importance. However, there is a lack of information on the mechanisms underlying the NH_3 emissions derived from livestock management. Use of passive sampling approaches may enhance our knowledge on NH_3 emissions by allowing systematic ecosystem investigations at a low cost; however, these techniques have not been critically evaluated for the Tropics. The main goals of our study are 1) to assess the livestock influence on the emissions of NH_3 in tropical ecosystems and 2) the evaluation of experimental techniques for estimation of NH3 emissions, which could be further implemented in Africa without investment in sophisticated analytical equipment.

The study was carried out in October 2014 at the farm of ILRI (Nairobi, Kenya). Ammonia fluxes from a fenced plot occupied by a herd of cows during daytime was estimated by both 1) the micrometeorological mass balance integrated horizontal flux (IHF) method and 2) the Eddy-covariance (EC) technique (using a sonic anemometer and a highly sensitive fast response NH_3 trace gas monitor). Passive flux samplers (PFS) internally coated with oxalic acid were installed at different heights in 1 central and 3 background masts. PFS were exchanged every 2 days and NH_3 trapped was measured colorimetrically. Soil N_2O emissions were also estimated by manual chambers every 48 h along with inorganic N contents in the topsoil.

Contrary to our expectations, NH_3 cow's presence did not triggered NH_3 emissions. Both IHF and EC showed very low NH_3 emission values along the experiment, although sensitivity varied among methods (about 100 and 30 ng NH_3 m^{-2} s^{-1} as obtained by the IHF method and EC, respectively). Heavy rainfall events (□120 mm) may be responsible for lowered NH_3 volatilization. Low soil nitrate concentrations, (<0.5 mg kg^{-1}), suggested predominant N leaching after rainfall. Soil N_2O emissions were negligible, showing a maximum of only 4.5 µg N-N_2O m^{-2} h^{-1} during the first day. These preliminary results represent the first dataset of NH_3 emissions under controlled conditions in tropical Africa, and provide the basis for further assessments of NH_3 emissions and evaluations of techniques under different ecosystems and management scenarios.